Real World Problems Name: _____

Write and solve an equation for each problem.

1. A strain of bacteria can grow from 3 to 15 in 3 hours. What is the rate of growth?

bacteria grows continuously!

$A = Pe^{rt}$

$15 = 3e^{3r}$

$5 = e^{3r}$

$3r = \ln 5$

$r = \frac{\ln 5}{3}$

$r = .536$

53.6%

2. A $50 baseball card is worth $400 in 5 year time. What is the rate of appreciation?

$400 = 50(1+r)^5$

$\sqrt[5]{8} = \sqrt[5]{(1+r)^5}$

$1.516 = 1 + r$

$.516 = r$

51.6%

3. How much will $500 earn if invested for 6% compounded continuously for 5 years.

$A = Pe^{rt}$

$A = 500e^{(.06 \times 5)}$

$A = 500e^{.3}$

$A = \$674.93$

$674.93 - 500 = \$174.93$

(amt. at end of term) − (initial amt) = interest earned

4. In 5 years, the mass of a 100 gram sample of an element is reduced to 75 grams. Find the rate of decay.

$75 = 100(1-r)^5$

$\sqrt[5]{.75} = \sqrt[5]{(1-r)^5}$

$.9441 = 1 - r$

$r = .056$

$r = 5.6\%$

5. Joan invested $1000 3 years ago. It is now worth $1276. If interest is compounded continuously, what is the interest rate?

$1276 = 1000e^{3r}$

$1.276 = e^{3r}$

$\ln 1.276 = 3r$

$.244 = 3r$

$.081 = r$

8.1%

6. The number of a certain strain of bacteria increases 77.5% per hour. How long will it take 2 bacteria to increase to 1000? bacteria grows continuously ☺

$A = Pe^{rt}$

$1000 = 2e^{.775t}$

$500 = e^{.775t}$

$\ln 500 = .775t$

$\frac{\ln 500}{.775} = t$

$t = 8.02$

$\approx$ 8 years

7. Jack deposited $100 in an account that pays 6% interest compounded continuously. When he withdrew the money, there was a balance of $200. How long ago did he open the account?

$200 = 100e^{.06t}$

$2 = e^{.06t}$

$\ln 2 = .06t$

$\frac{\ln 2}{.06} = t$

$11.55 = t$

$\approx 11\frac{1}{2}$ years

8. The intensity of an earthquake is measured on the Richter Scale. The formula is $R = \log_{10} I$, where R is the measurement on the Richter Scale and I is the Intersity.

a. What is the intensity of an earthquake which had a measurement of 7.7 on the Richter Scale?

$7.7 = \log_{10} I \qquad I = 10^{7.7}$ → $I = 50,188,723.36$

b. What is the intensity of an earthquake which had a measurement of 4.2 on the Richter Scale?

$4.2 = \log_{10} I \qquad I = 10^{4.2}$ → $I = 15,848.93$

c. What is the Richter Scale measurement of an earthquake with an intensity of 630957?

$R = \log_{10} 630,957$ → $R = 5.80$

d. What is the Richter Scale measurement of an earthquake with an intensity of 158489319?

$R = \log_{10} 158,489,319$ → $R = 8.20$

9. How long will it take for an investment to double if it is placed in an account that earns 6.5% annual interest compounded monthly?

$2 = \left(1 + \frac{.065}{12}\right)^{12t}$

$2 = 1.0054^{12t}$

$12t = \log_{1.0054} 2$ → $12t = \frac{\log 2}{\log 1.0054}$

$\frac{12t}{12} = \frac{128.707}{12}$

$t = 10.73$ → ≈ 10 years, 9 months

10. How long will it take an investment to triple in an account that pays 8.5% compounded continuously?

$3 = e^{.085t}$

$.085t = \ln 3$ → $t = \frac{\ln 3}{.085}$

$t = 12.92$ → ≈ 12 years, 10 months

11. How long will it take $400 to reach $1600 if it is placed in an account that pays 6% compounded quarterly?

$1600 = 400\left(1 + \frac{.06}{4}\right)^{4t}$

$4 = 1.015^{4t}$

$4t = \log_{1.015} 4$ → $4t = \frac{\log 4}{\log 1.015}$

$\frac{4t}{4} = \frac{93.111}{4}$

$t = 23.278$ → ≈ 23 years + 3 months

12. A piece of machinery valued at $250,000 depreciates 12% per year by the fixed rate method. After how many years will the value have depreciated to $100,000?

$100,000 = 250,000(1 - .12)^t$

$.4 = .88^t$

$t = \log_{.88} .4$ → $t = \frac{\log .4}{\log .88}$

$t = 7.17$ → ≈ 7 years

13. An investment service promises to triple your money in 12 years. Assuming continuous compounding of interest, what rate of interest will be needed to triple your ~~12 years~~ money?

$A = Pe^{rt}$

$3 = e^{12r}$

$\frac{12r}{12} = \frac{\ln 3}{12}$ → $r = \frac{\ln 3}{12}$

$r = .092$ → 9.2%